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**WHAT IS CLAIMED IS:**

1. An illumination device having
  - a light source (1);
  - an optical waveguide;
  - a coupling-in optical system (3) which couples the light of said light source (1) into a first end of said waveguide;
  - a coupling-out optical system (5) which couples out the light emerging from a second end of said optical waveguide; and
  - an illuminating optical system (17; 20) which receives the light emerging from said coupling-out optical system (5) and illuminates an image field,comprising:
  - a) an optical fiber bundle (4) which is arranged as said optical waveguide; and
  - b) a homogenizing optical system (6) which is arranged between said coupling-out optical system (5) and said illuminating optical system (17; 20), wherein said homogenizing optical system (6) homogenizes the nonuniform intensity distribution in the image field of the light emerging from said optical fiber bundle (4).
  
2. An illumination device having
  - a light source (1);
  - an optical waveguide;
  - a coupling-in optical system (3) which couples the light of said light source (1) into a first end of said waveguide;
  - a coupling-out optical system (5) which couples out the light emerging from a second end of said optical waveguide; and

- an illuminating optical system (17; 20) which receives the light emerging from said coupling-out optical system (5) and illuminates an image field,  
comprising:
  - a) an optical fiber bundle (4) which is arranged as said optical waveguide;  
and
  - b) a homogenizing optical system (6) which is arranged between said coupling-out optical system (5) and said illuminating optical system (17; 20), wherein said homogenizing optical system (6) homogenizes the nonuniform intensity distribution in the image field of the light emerging from said optical fiber bundle (4),
  - c) wherein said homogenizing optical system (6) comprises a micro-honeycomb condenser (7) and a lens member (8) which superimpose the exit opening of said fiber bundle (4) in an intermediate image plane (10) to form a homogeneous intermediate image.

3. An illumination device having

- a light source (1);
- an optical waveguide;
- a coupling-in optical system (3) which couples the light of said light source (1) into a first end of said waveguide;
- a coupling-out optical system (5) which couples out the light emerging from a second end of said optical waveguide; and
- an illuminating optical system (17; 20) which receives the light emerging from said coupling-out optical system (5) and illuminates an image field,  
comprising:
  - a) an optical fiber bundle (4) which is arranged as said optical waveguide;  
and
  - b) a homogenizing optical system (6) which is arranged between said coupling-out optical system (5) and said illuminating optical system (17;

20), wherein said homogenizing optical system (6) homogenizes the nonuniform intensity distribution in the image field of the light emerging from said optical fiber bundle (4),

- c) wherein the light of said light source (1) is picked off via said coupling-in optical system (3) having a large numerical entrance aperture and is coupled into said optical fiber bundle (4).

4. An illumination device having

- a light source (1);
- an optical waveguide;
- a coupling-in optical system (3) which couples the light of said light source (1) into a first end of said waveguide;
- a coupling-out optical system (5) which couples out the light emerging from a second end of said optical waveguide; and
- an illuminating optical system (17; 20) which receives the light emerging from said coupling-out optical system (5) and illuminates an image field,

comprising:

- d) an optical fiber bundle (4) which is arranged as said optical waveguide; and
- e) a homogenizing optical system (6) which is arranged between said coupling-out optical system (5) and said illuminating optical system (17; 20), wherein said homogenizing optical system (6) homogenizes the nonuniform intensity distribution in the image field of the light emerging from said optical fiber bundle (4),
- f) wherein the light of said light source (1) is picked off via said coupling-in optical system (3) having a large numerical entrance aperture  $NA \geq 0.60$  and is coupled into said optical fiber bundle (4).

5. A coordinate measuring instrument having

- a horizontally X-Y displaceable measurement stage (26) for receiving a substrate with a feature (31) that is to be measured;

- an illumination system with a light source (1), an optical waveguide (4), a coupling-in optical system (3) before the optical waveguide (4), a coupling-out optical system (5) after the optical waveguide (4), and an illuminating optical system (17; 20) for illuminating an image field; and
- a detector device (14) for determining the position of the feature, comprising:
  - a) an optical fiber bundle (4) which is arranged as said optical waveguide; and
  - b) a homogenizing optical system (6) which is arranged between said coupling-out optical system (5) and said illuminating optical system (17; 20), said homogenizing optical system (6) homogenizes the nonuniform intensity distribution in the image field of the light emerging from the optical fiber bundle (4).

6. A coordinate measuring instrument having

- a horizontally X-Y displaceable measurement stage (26) for receiving a substrate with a feature (31) that is to be measured;
- an illumination system with a light source (1), an optical waveguide (4), a coupling-in optical system (3) before the optical waveguide (4), a coupling-out optical system (5) after the optical waveguide (4), and an illuminating optical system (17; 20) for illuminating an image field; and
- a detector device (14) for determining the position of the feature, comprising:
  - a) an optical fiber bundle (4) which is arranged as said optical waveguide;
  - b) a homogenizing optical system (6) which is arranged between the coupling-out optical system (5) and the illuminating optical system (17; 20), said homogenizing optical system (6) homogenizes the nonuniform intensity distribution in the image field of the light emerging from the

optical fiber bundle (4), said homogenizing optical system (6) comprising a micro-honeycomb condenser (6) and a lens member (8) which superimpose the exit opening of the fiber bundle (4) in an intermediate image plane (10) to form a homogeneous intermediate image.

7. A coordinate measuring instrument having
  - a horizontally X-Y displaceable measurement stage (26) for receiving a substrate with a feature (31) that is to be measured;
  - an illumination system with a light source (1), an optical waveguide (4), a coupling-in optical system (3) before the optical waveguide (4), a coupling-out optical system (5) after the optical waveguide (4), and an illuminating optical system (17; 20) for illuminating an image field; and
  - a detector device (14) for determining the position of the feature, comprising:
    - a) an optical fiber bundle (4) which is arranged as said optical waveguide;
    - b) a homogenizing optical system (6) which is arranged between said coupling-out optical system (5) and said illuminating optical system (17; 20), said homogenizing optical system (6) homogenizes the nonuniform intensity distribution in the image field of the light emerging from the optical fiber bundle (4).
    - c) wherein the light of said light source (1) is picked off via said coupling-in optical system (5) with a large numerical entrance aperture, and is coupled into said optical fiber bundle (4).
8. A coordinate measuring instrument having
  - a horizontally X-Y displaceable measurement stage (26) for receiving a substrate with a feature (31) that is to be measured;

- an illumination system with a light source (1), an optical waveguide (4), a coupling-in optical system (3) before the optical waveguide (4), a coupling-out optical system (5) after the optical waveguide (4), and an illuminating optical system (17; 20) for illuminating an image field; and
- a detector device (14) for determining the position of the feature, comprising:
  - a) an optical fiber bundle (4) which is arranged as said optical waveguide;
  - d) a homogenizing optical system (6) which is arranged between said coupling-out optical system (5) and said illuminating optical system (17; 20), said homogenizing optical system (6) homogenizes the nonuniform intensity distribution in the image field of the light emerging from the optical fiber bundle (4).
  - e) wherein the light of said light source (1) is picked off via said coupling-in optical system (5) with a large numerical entrance aperture  $NA \geq 0.60$ , and is coupled into said optical fiber bundle (4).